

CURTIN UNIVERSITY
PROJECT DELIVERY GUIDELINES

AUDIOVISUAL GUIDELINES
PART 2 – TECHNICAL
DESIGN STANDARDS
000319



Curtin University

TEACHING, LEARNING AND MEETING SPACES

ABSTRACT

The purpose of this document is to provide the technical standards and performance verification associated with the design and installation of audiovisual systems in teaching, learning and meeting spaces at Curtin University.

<i>Details of revisions</i>			
<i>Level</i>	<i>Details</i>	<i>Date</i>	<i>Initial</i>
<i>1</i>	<i>Original document created from Audio Visual Standards Part 2 - Technical Design Standards (v0.4)</i>	<i>Dec-16</i>	<i>RPS</i>
<i>2</i>	<i>Overall review of content. Minor modifications and updates including labelling and network patching</i>	<i>Jun-18</i>	<i>IRC</i>
<i>2</i>	<i>Inclusion of wording to allow departures from the existing guideline</i>	<i>Dec-19</i>	<i>RPS</i>

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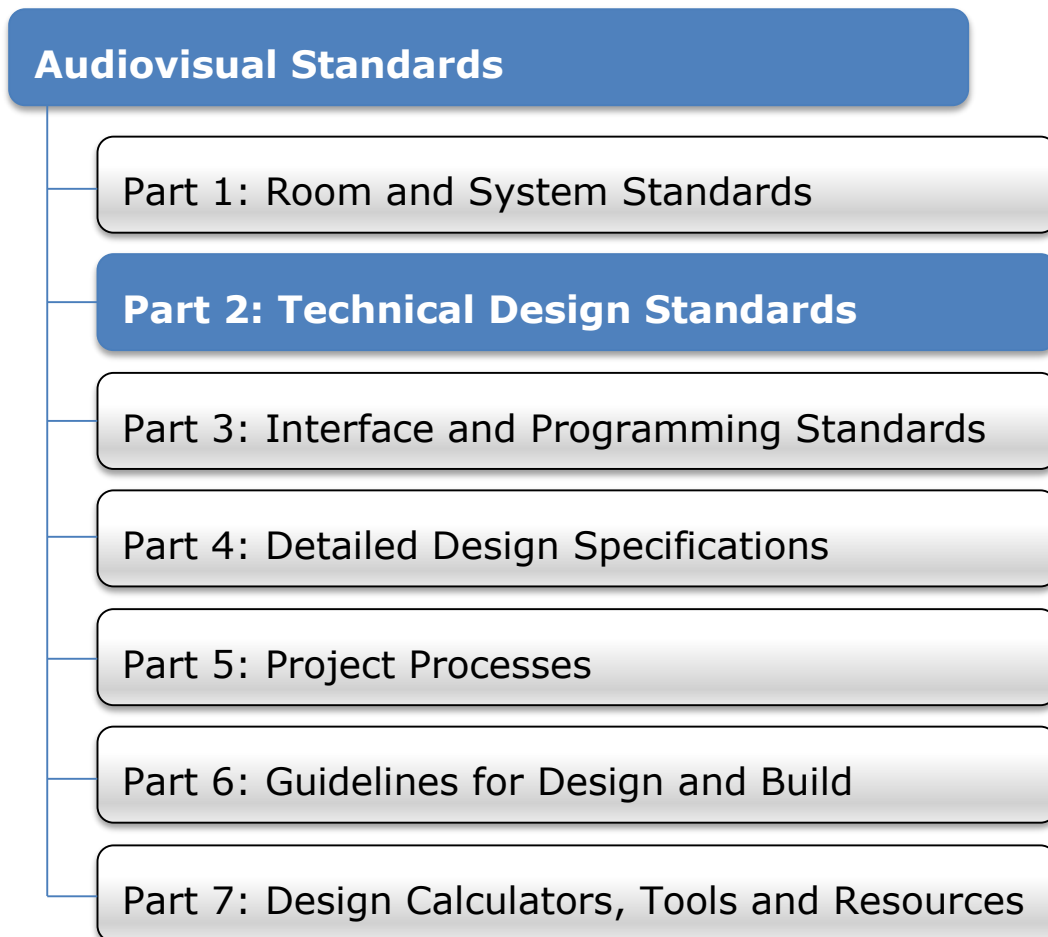
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RELATED DOCUMENTS

Title	Version	Date	Location
AETM Audio Visual Design Guidelines – Tertiary Teaching Spaces	2 nd Edition	2012	www.aetm.org
Infocomm AV/IT Infrastructure Guidelines for Higher Education	1 st Edition	2014	www.infocomm.org
Infocomm F501.01 Cable Labelling for Audiovisual Systems	V1	2015	www.infocomm.org
Audiovisual Systems Performance Verification Guide (for use with ANSI/Infocomm 10:2013)		2014	www.infocomm.org
000313 Data Cabling Network Requirements	Rev 1	2016	www.properties.curtin.edu.au
000312 Electrical Services Guidelines	Rev 1	2016	www.properties.curtin.edu.au

Audiovisual Standards Part 2 – Technical Design Standards



1 INTRODUCTION

1.1 DOCUMENT BRIEF

This Project Delivery Guidelines document provides technical design standards and performance verification for teaching, learning and meeting spaces at Curtin University. The intended audience is audiovisual consultants, integrators and project managers. The objectives of this standards document are to ensure consistent interpretation of technical requirements, and consistent delivery of functioning and maintainable spaces.

Section 2 outlines the general guidelines and expectations for installations and conditions of AV system design at Curtin.

Section 3 describes the installation standards for the components of AV systems including audio, video and control devices, as well as input and output endpoints. The performance verification items for audio, video and control of completed systems are provided.

Section 4 describes the installation and verification items for related services and the environment containing AV systems.

The definitions that apply to this document are listed in the Glossary of Terms in Appendix A.

The Project Delivery Guidelines have been prepared in consultation with Curtin University subject matter experts and stakeholders. It is recognised that the subject matter of Guidelines will not always be suitable for all project elements and departures from the Guidelines may be required or desirable. Departures from Guidelines must be agreed upon in consultation with the relevant University Guideline subject matter expert. Departures must be recorded in a project register and recorded and reviewed in the Project Control Group meeting minutes under its own meeting agenda item "Project Delivery Guideline Departures". Where the University subject matter expert identifies that a departure adds ongoing value to the University, the subject matter expert will update the relevant Guideline.

1.2 DOCUMENT ACCESS

All Curtin IT Services staff and contracted personnel are provided access to this document.

Designers, integrators and contractors must ensure they have the most current version of all standards prior to engaging in any work.

The most recent version of this document can be found on the web at:
<https://properties.curtin.edu.au/workingwithus/>.

1.3 RELATED DOCUMENTS

This standards document, and the collection of standards to which it belongs, is aimed at providing clear guidance to contractors and staff engaged to undertake audiovisual works in University teaching spaces and meeting rooms.

Other related documentation is listed in the Document Control section of this document.

1.4 CLARIFICATION

Whenever a conflict of information occurs or clarification of instruction is required, all queries shall be made to the relevant CITS–AV Project Facilitator.

1.5 NON-STANDARD CONFIGURATIONS

All non-standard implementations must be approved in writing by the AV Standards Manager strictly on a case-by-case basis.

1.6 ROLES AND RESPONSIBILITIES

Table 1: Roles and Responsibilities

Role	Responsibility
AV Standards Manager	Owner of the document. Maintains currency and approvals through document control and versioning.
CITS–AV Project Facilitator	Act as liaison for design and build professionals in discussions relating to the content of this document.
CITS–AV Project Staff	Refer to this document in discussions with design and build professionals. Contribute to maintaining the document currency.
Portfolio Manager (PF&D)	Ensures that the latest version of this document is provided to the AV Consultant early in the project initiation phase.
AV Consultant	Reads and understand these standards before conducting design activities relating to teaching, learning and meeting spaces at Curtin University.
External Contractor or Provider (e.g. AV Integrator)	Reads and understand these standards before conducting installation activities at Curtin University.

2 AV SYSTEM DESIGN GUIDELINES

This section describes the design guidelines for an audiovisual (AV) system being installed at Curtin University, specifically targeted at the AV Consultant and AV Integrator. The broader description of the design guidelines for the incorporation of AV systems into venues, particularly for other design and build professionals such as architects, can be found Part 6 in these standards.

2.1 FIT FOR PURPOSE

The installed AV system shall be fit for purpose. The AV Integrator must supply all items necessary to provide a fully working system in line with the AV functional and technical requirements.

2.2 QUALITY OF WORKS

All work carried out by the AV Integrator must be complete in all respects, built to highest quality and comply with relevant Australian standards, University standards and industry best practices. Further, works shall be conducted in a professional manner using competent and experienced personnel with relevant qualifications for their trade or profession.

The equipment used in the work:

- must be selected from the Curtin standard component list (see Part 7 – Resource 3) unless alternative samples are approved
- must be new and installed to manufacturer's installation instructions unless otherwise approved
- must be from a reputable manufacturer with local support, and be of commercial grade.

2.3 SYSTEM PERFORMANCE

All AV systems must meet the performance requirements described in Section 3.7 through to Section 3.9.

With regard to video performance:

- Resolution for projectors and displays must be 1920 x 1080 @ 60 Hz.
- Projectors and displays must be bright enough to be seen when the room is at full illumination including natural light.
- Projection surfaces must have a gain of 1.0.
- Image quality must deliver clarity in picture, colour, resolution, contrast and focus across the range of audience viewing positions.

With regard to audio performance:

- Audio playback must be free of audible artefacts such as distortion, echoes, hum, noise, crackle.
- Speakers and ceiling microphones must be grid positioned to provide the most uniform audio coverage and pickup.
- Microphones must be free of feedback in areas of common use.

- Amplifiers must provide sufficient power to the speakers based on the room size.

2.4 SERVICEABILITY

For serviceability there must be easy access to all equipment. For racked equipment this means front and rear access and this access must not introduce OHS hazards (e.g. a small rolling rack must be on a flat surface with no step). For ceiling-mounted projectors over tiered seating, this may mean the installation of a motorised lift. For equipment behind access panels, this means adequate clearance to be able to connect cables and/or remove units for servicing.

2.5 AESTHETICS

There shall be no exposed equipment racks in a venue. Instead the equipment shall be installed in a lectern or presentation desk (teaching space), credenza (meeting room), or a rack within a nearby communications or service room.

2.6 ACCESSIBILITY

Consideration must be given to the height and location of equipment that is accessed by users, including those with a disability. All user interfaces (e.g. touch panels, keypads), and wall plates must be installed at an accessible height and be free from obstructions.

Any interactive whiteboards or flat panel displays with touch overlays must be installed so that the top of the board is no higher than 2.1 metres above floor level.

2.7 HEAT DISSIPATION

The design of racks or joinery containing AV equipment must include a consideration of air flow or cooling to keep equipment within the manufacturer's specified temperature limits (which in any case must not exceed 35 °C). Natural ventilation through convection is to be used where possible, with the size and location of ventilation holes in joinery to be coordinated with the builder. The use of low noise or low revolution fans is permitted if necessary.

2.8 NOISE ISOLATION

Noise from equipment and cooling fans must be isolated where possible to remain within acceptable limits for ambient noise in the venue (typically less than 35 dB A-weighted).

2.9 ASSET LABELS

If supplied by Curtin, asset labels are to be affixed to equipment by the AV Integrator in a location clearly visible from front or rear, without obstruction.

2.10 MOUNTINGS AND FASTENINGS

All equipment shall be firmly mounted in position as per the manufacturer's recommendations.

Some specific equipment, such as digital receivers, can be attached behind flat panel displays (FPDs), above projectors or on the underside of tables but never within floor boxes, ceilings, or walls.

When mounting small components, self-adhesive Velcro is to be used as a last resort. Preference is for manufacturer-supplied rack mounts, rack mount trays, under-table mount kits or custom mount kits.

The selection of fasteners must be appropriate for duty and loading. The use of threaded fastening is preferred to allow for removal and replacement. The AV Integrator must obtain engineering certifications for suspended equipment as required.

2.11 PENETRATIONS

Penetrations of existing structures are not to be made without Curtin PF & D approval.

All penetrations are to be acoustically sealed to maintain the acoustic properties of the wall or floor being penetrated. Ducts are to have at least one 90° bend prior to a wall penetration.

2.12 SPECIFICATIONS

2.12.1 HDMI

HDMI is to be used as the base standard for all digital signals in new installations. At a minimum the following devices will require a HDMI interface – resident PC, laptop connection, document camera, wireless presenter, media players, video projectors and flat panel displays. These devices must comply with at least HDMI 2.x, including the protocols enabling Hot Plug Detect, EDID, CEC, HDCP, and Fast HDMI switching with 'keep alive' HDCP link.

2.12.2 EDID

All video switching solutions must support EDID 1.4 as a minimum and allow editing of the display EDID tables. Any output device must support 720p and 1080p connections.

2.12.3 HDCP

All supplied source devices that support HDCP content must provide sufficient HDCP keys (KSV – Key Selection Vector) to allow all display devices to display HDCP content. All video switching solutions must provide KSV caching to minimise switching delays and generate a sufficient number of HDCP keys to accommodate all connected displays. The HDCP authentication must be capable of being switched off within AV switches so that devices (e.g. Mac computers) can be forced to transmit non-encrypted content without HDCP protection.

2.12.4 HDBASET

Any implementation of HDBaseT must meet the HDBT 2.0 or higher specification.

2.12.5 VGA

VGA connectivity is not to be offered in new installations.

2.13 APPLICABLE STANDARDS

Any works shall be carried out in accordance with the Curtin guidelines, standards and specifications identified in tender or contract documents. In the event of conflicting requirements the order of precedence shall be:

1. statutory codes and regulations
2. mandatory codes and standards
3. this standards document
4. specifications within tender or contract
5. referenced Australian and international standards.

Table 2: Relevant Australian and International Standards

Standard	Version	Description
ANSI/INFOCOMM 1M	2009	Audio Coverage Uniformity in Enclosed Listener Areas
ANSI/INFOCOMM 3M	2011	Projected Image System Contrast Ratio
ANSI/INFOCOMM 4	2012	Audiovisual Systems Energy Management
ANSI/INFOCOMM 10	2013	Audiovisual Systems Performance Verification
ANSI/INFOCOMM V202.01	2016	Display Image Size for 2D Content in Audiovisual Systems
AS1044		Limits of Electromagnetic Interference
AS1428.1	2009	Design for Access and Mobility - General Requirements for Access
AS1428.5	2010	Design for access and mobility – Communication for people who are deaf or hearing impaired
AS60118.4	2007	Hearing aids – Magnetic field strength in audio-frequency induction loops for hearing aid purposes
AS/ACIF S008	2006	Requirements for Authorised Cabling Products
AS/ACIF S009	2006	Installation requirements for Customer Cabling (Wiring Rules)
AS/NZS2589	2007	Gypsum linings – Application and Finishing
AS/NZS3000	2007	Electrical Installations
AS/NZS3080	2003	Telecommunications Installations – Generic Cabling for Commercial Premises

AS/NZS3084	2003	Telecommunications Installation – Telecommunications Pathways and Spaces for Commercial Buildings.
AS/NZS3760	2010	In-service Safety Inspection and Testing of Electrical Equipment
AS/NZS4117	1999	Surge protective devices for telecommunications applications
AS/NZS60950.1	2011	Information technology equipment – Safety, Part 1: General requirements
AS/NZS CISPR 14.1	2010	Electromagnetic Compatibility – Requirements for household appliances, electrical tools and similar apparatus –Emission
AS/NZ3350.1	2002	Safety of household and similar electrical appliances – General requirements
AS/NZS60065	2012	Audio, video and similar electronic apparatus – Safety requirements
AS/NZS IEC 61935.1	2006	Testing of balanced communication cabling in accordance with ISO/IEC 11801 – Installed cabling
AS/NZS IEC 61935.2	2006	Testing of balanced communication cabling in accordance with ISO/IEC 11801 – Patch cords and work area cords
CE marked		Complying with EEC directives 73/23 "low voltage" and 89/336 "electromagnetic compatibility".
C-tick		Complying with Australia and New Zealand EMC Framework requirements.
DDA	1992	Disability Discrimination Act (Commonwealth)
IEC 60268 Pt.1-17		Sound System Equipment
IEC 118-3 Ed.1	1996	Hearing Aids Part 1–9
INFOCOMM F501.01	2015	Cable Labelling for Audiovisual Systems
National Construction Code (ABCB)	2016	Volume 1 – Building Code of Australia Class 2 to Class 9 Buildings

3 AV SYSTEM INSTALLATION AND PERFORMANCE

This section describes the design standards that relate to the installation of components that compose the standard Curtin AV System types (see Part 4). These components must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless written approval is obtained from the CITS–AV Project Facilitator.

This section also provides verification items for performance of the installed AV system.

3.1 AUDIO COMPONENTS

3.1.1 LECTERN MICROPHONE

The stalk of the lectern microphone must be an appropriate length, and with a suitable polar pattern, for high quality voice pick-up from the normal standing position of a presenter. The microphone must be installed in a rubber shock mount as per the manufacturer's instructions. Cables are to be securely connected, labelled and neatly arranged. The microphone audio must be free of artefacts such as hum, phasing, crosstalk and interference.

In lecture theatres, the lectern microphone is located on the lectern, as shown in the layout diagram of Appendix B.

3.1.2 BOUNDARY OR TABLE MICROPHONE

The boundary microphone must be located on the table or lectern surface to obtain an optimal range of voice pick-up for likely presenter positions. Cables are to be securely connected, labelled and neatly arranged. The microphone audio must be free of artefacts.

In lecture theatres and classrooms, the boundary microphone is located on the lectern (or AVIP), as shown in the layout diagram of Appendix B. In meeting rooms, the table microphones are to be located central to the available seats and orientated to suit the polar pattern and range.

3.1.3 WIRELESS MICROPHONE SYSTEM

The receiver for the wireless microphone system is to be located appropriately and with power level configured to ensure the system is free of interference and dropouts across the venue. The DIP switches are to be set as per Curtin recommendations (see Part 7 – Resource 4).

In lecture theatres and classrooms, the charger for the wireless microphones is located on the lectern (or AVIP), as shown in the layout diagram of Appendix B. The charger for the microphones must be secured in place.

3.1.4 LAPEL MICROPHONE

For Revolabs systems, the microphone must be properly paired with the receiver. The mute button on the microphone is to be disabled with the microphone set to automatically mute when undocked from the charger. A lanyard is to be fitted to at least one microphone. The whole system is to be tested to ensure that the microphone audio is free of artefacts such as hum, phasing, crosstalk and interference.

3.1.5 HANDHELD MICROPHONE

The handheld microphone should have a cardioid polar pickup pattern. For Revolabs systems, the microphone must be configured similarly to the lapel microphone. Special care must be taken to ensure that the handheld microphone sits properly in the charging base, as it has a high centre of gravity.

3.1.6 CEILING MICROPHONE GRID

Each ceiling microphone must be designed specifically for ceiling installation, look unobtrusive, and have a polar pattern to suit the application. The microphone must be located at 2,200 mm AFFL, unless otherwise specified. It should be within a regular grid pattern, including correct angling to maximise pick-up from the likely presenter positions. Curtin AV Project staff should be consulted regarding the grid pattern before installation.

The cable for each microphone is to be securely connected, correctly labelled and fitted with strain relief. The microphones must not interfere with any projected image. The whole system is to be tested to ensure that the microphones are free of audio artefacts.

3.1.7 USB CONFERENCE MICROPHONE

Where table services are provided, the USB conference microphone is to be secured to the table in the optimum location for pick-up from the likely presenter position.

For a wireless USB conference microphone, the optimum location shall be marked with a notice indicating where and how to connect the device to the nearby charger/cable.

3.1.8 DIGITAL SIGNAL PROCESSOR

The digital signal processor (DSP) shall reproduce all frequencies within the audible spectrum smoothly. Excessive equalisation should be avoided. The maximum preset levels shall not exceed a hard limit of 6dB below the point at which feedback will occur.

For videoconferencing applications, audio echo cancellation (AEC) must be configured per microphone channel with the ability to activate/deactivate as required.

The Curtin-supplied template for the DSP must be used as the basis for the audio processing configuration. The audio routing and processing diagram in Appendix C provides an overview of the requirements. Curtin AV Project staff should be consulted before implementing a final solution.

The digital signal processor shall be installed in its rack location with all cables securely connected, labelled and neatly arranged.

3.1.9 AMPLIFIER

The audio amplifier must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. The amplifier shall have the following characteristics:

- power output capable of driving the nominated speakers to their maximum SPL with 20 per cent headroom
- 100-volt line or low-impedance output as determined by application
- harmonic distortion less than 0.2 per cent
- frequency response between 20 Hz and 20 kHz
- signal to noise ratio >90dB
- I/O as determined by application.

The audio amplifier shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. To ensure correct operation after the sound system has been calibrated, ensure that exposed front panels are installed with tamper-proof devices over any knobs, switches or other controls.

3.1.10 FRONT OF HOUSE LOUDSPEAKERS

The front of house (FOH) loudspeakers must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. The loudspeakers, which are normally used for 'program" audio only, shall have the following characteristics:

- dispersion pattern and power output to be chosen to suit the venue
- frequency range between 80 Hz and 16 kHz (-10dB)
- low impedance
- SPL of 88dB @ 1W, 1m.

The FOH loudspeakers must be securely mounted, typically on the main presentation wall located on either side of the screen at least halfway between the edge of the screen and the side wall. Curtin AV Project staff should be consulted before installation into final position. The speakers must be located to ensure that the viewing area is uninterrupted for all audience positions. The speaker enclosures are to be focused towards the centre of the venue.

3.1.11 CEILING SPEAKERS

The ceiling speakers must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. The speakers, which are normally used for speech reinforcement applications, shall have the following characteristics:

- power output to be chosen to suit the venue

- 110° conical coverage
- frequency range of 80 Hz to 16 KHz
- SPL of 88dB @1W, 1m
- 100-volt line or low-impedance.

The placement of ceiling speakers must be in a regular grid pattern, where possible, which provides partial overlap of speaker coverage. Curtin AV Project staff should be consulted before installation into final position.

The installation must ensure any ceiling speakers are structurally supported or that weight distribution measures are taken to ensure ceiling tiles don't sag. In general, install using the ceiling mount kit and back cans available with speakers. All ceiling speakers must be recessed within the ceiling cavity.

The correct speaker tapping settings for 100/70 V and low impedance speakers must be used. If unsure seek onsite approval from Curtin AV Project staff.

3.1.12 HEARING AUGMENTATION SYSTEM

For induction loop hearing augmentation systems, the loops must provide 80 per cent coverage of the area receiving audio amplification in the venue. The loops must be installed below floor coverings using flat copper tape. If loops cannot be installed due to lack of floor coverings or bare concrete floors, an alternative solution must be coordinated with the Curtin AV Project team. Induction loop systems must be installed in an 'ultra-low loss phased array' configuration to ensure that audio from one space cannot leak into adjacent spaces.

As a minimum, the induction loop system must meet the following criteria:

- Field strength inside the area of use must be equal to 400 mA/m \pm 3dB (tested with 125 ms RMS measurement with 1 kHz sine wave).
- Total variation in signal across the frequency band 100Hz to 5kHz at 1kHz must be within 3dB anywhere in the loop area.
- Background noise must be less than or equal to -32dB relative to 400 mA/m.

For infrared hearing augmentation systems, the transmitter(s) must be securely fixed to the wall, located and angled to provide 95 per cent coverage of the area receiving audio amplification in the venue. Multiple transmitters may be required to ensure correct operation. Transmitters must not be installed outside or in direct sunlight. The number of receivers must correspond to the number of people the space accommodates to meet NCC regulations (e.g. two receivers for a capacity < 50 persons). An induction neck loop option must be provided for each receiver supplied. A recharger and rechargeable batteries must be provided for each receiver.

In either case, the venue shall be clearly labelled with signage that complies with current building codes and Australian standards. A complete set of written test results must be provided with each system, including a certificate of compliance as per AS1428.5-2010.

3.1.13 TELEPHONE INTERFACE

The telephone interface shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. During testing the telephone conversation audio from the 'far end' must be clearly heard through the venue speakers. Similarly, the venue microphones must transmit clearly through the telephone line to the far end.

3.2 VIDEO COMPONENTS

3.2.1 MEDIA SWITCHER/FRAME

The media switcher/frame shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device is to be configured as per Curtin recommendations (see Part 7 – Resource 4) with the following as a minimum:

- EDID favourites set to 720p and 1080p (default) with LPCM 2Ch audio in all inputs
- HDCP compliance turned off on guest media inputs and for Apple devices (e.g. Apple TV)
- all inputs and outputs named
- front panel locked.

The security credentials (admin password) are to be set as the Curtin default.

3.2.2 VIDEO EXTENDER

For video extenders, such as Extron's DTP/XTP receivers and transmitters, the following installation standards must be followed:

- mounted securely – vertical in ceiling, behind flat panel, or side by side on rack shelf
- adequately ventilated – units not stacked or mounted upside down
- easily accessible for maintenance
- clearly labelled, indicating which device the extender is associated with
- power can be cycled from rack or AVIP.

Where fitted above the ceiling, the location of the extender must be indicated with a label attached to a permanent part of the ceiling (e.g. ceiling supports rather than moveable tiles), clearly legible from floor level.

3.2.3 VIDEO STREAMING

For video streaming units, the installation standards are the same as those for video extenders.

3.2.4 USB EXTENDER

For USB extender units, the installation standards are similar to those of video extenders (without the need to be power cycled from the rack or AVIP).

3.2.5 AV BRIDGE

The AV bridge will be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device is to be configured as per Curtin recommendations (see Part 7 – Resource 4), with the following as a minimum:

- video input is HDMI
- audio input is balanced
- streaming output is USB
- front panel is locked.

The security credentials (admin password) are to be set as the Curtin default.

3.3 CONTROL COMPONENTS

3.3.1 KEYPAD CONTROLLER

The keypad controller must be securely mounted and appropriately positioned (e.g. accessible by a person in a wheelchair). The button layout, function and labelling must be consistent with the Curtin standard (see Part 3 – Section 3).

The security credentials (admin password) are to be set as the Curtin default.

3.3.2 TOUCH PANEL

The touch panel must be calibrated and configured as per Curtin recommendations (see Part 7 – Resource 4), with the following as a minimum:

- motion sense set to enable the panel to wake on movement
- motion setting value selected to be able to detect a person standing behind the lectern
- sleep timer 10 minutes
- automatic date/time setting disabled.

The graphical user interface must be consistent with the Curtin standard (see Part 3 – Section 3).

In lecture theatres and classrooms, the touch panel is located on the lectern (or AVIP), as shown in the layout diagram of Appendix B. In meeting rooms, the touch panel is located on the meeting table if a network outlet available, otherwise on the top of the credenza housing the AV equipment.

The security credentials (admin password) are to be set as the Curtin default.

3.3.3 CONTROL PROCESSOR

The control processor shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device is to be configured as per Curtin recommendations (see Part 7 – Resource 4), with the following as a minimum:

- controller registered as a client gateway within RMS (<http://rms.av.curtin.edu.au/rms>)

- NTP and time zone – ntp.curtin.edu.au (GMT+8).

The security credentials (admin password) are to be set as the Curtin default.

3.3.4 LIGHTING GATEWAY

The lighting gateway supplied by the electrical contractor must be tested for each lighting scene preset as provided.

3.3.5 BLINDS

The operation of the blinds must be tested for the up, down and stop functions as provided on the touch panel for each group as provided.

3.3.6 PRESSURE MAT

The pressure mat must be secured to the floor with its cable concealed as much as possible. It should be recessed into the carpet.

3.3.7 OCCUPANCY SENSOR

The occupancy sensor must be secured to the ceiling in an appropriate position to detect typical motion in a venue. The sensor must be tested to ensure consistency of detection.

3.3.8 UNINTERRUPTIBLE POWER SUPPLY

The UPS must be installed to manufacturer's instructions and tested for operation under power-off and return conditions.

3.3.9 POWER CONTROLLER

The power controller shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device must be configured for delay times, port labels and device names as per Curtin recommendations (see Part 7 – Resource 4) and as shown in the venue's schematics. The individual power switching functionality must be tested via its web interface. The individual ports of a power controller are not to be shared across venues as this makes labelling and support difficult.

The security credentials (admin password) are to be set as the Curtin default.

3.4 INPUT ENDPOINTS

3.4.1 RESIDENT COMPUTER

The specifications for the resident computer should be the following, as a minimum:

- Curtin enterprise model
- six rear UTP ports, two of which must be v3.0
- two Displayports
- SSD storage

- capable of 1080p resolution
- imaged with Curtin SOE for Lab (Classrooms) or Staff (Meeting Spaces).

In lecture theatres and classrooms, the wired keyboard and mouse is located on the lectern (or AVIP), as shown in the layout diagram of Appendix B. In meeting rooms, a wireless keyboard and mouse is normally provided.

The resident computer shall be installed by the AV Integrator using the following standards:

- all cabling securely connected, correctly labelled, neatly arranged and with sufficient slack for serviceability
- USB cables attached to rear ports only
- if wired keyboard and mouse present – sufficient cable slack and strain relief
- if wireless keyboard and mouse present – dongle in rear of PC and the charger fixed in a user-accessible location
- computer attached with a Kensington lock and secured to the equipment rack
- if located behind a panel or door, ensure computer power button, USB ports and DVD tray are accessible via a cut-out.

3.4.2 COMPUTER MONITOR

The specifications for the computer monitor should be the following, as a minimum:

- Curtin enterprise model
- 24" diagonal
- 16:9 format.

In lecture theatres and classrooms, the computer monitor shall be attached onto an articulated arm located on the lectern (or AVIP), as shown in the layout diagram of Appendix B. In meeting rooms, the resident computer is normally fitted without a monitor as the flat panel display serves this purpose.

The computer monitor shall be securely mounted to the arm (not sagging down, loose etc.).

3.4.2.1 Interactive Monitor

If the monitor is interactive, it may be fixed to the lectern using the supplied stand so as to allow the monitor to be adjusted from upright to almost horizontal. The interactivity must be properly calibrated, configured and tested.

3.4.2.2 Auxiliary Digital Video Connection

The housing for the auxiliary digital video connection must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved.

In lecture theatres and classrooms, the auxiliary digital video connection is normally located in a cable cubby on the lectern (or AVIP), as shown in the layout diagram of Appendix B. In meeting rooms, the auxiliary digital video connection is normally located in a table box.

For the HDMI cable supplied, the following installation guidelines should be applied:

- HDMI cable is small gauge, flexible, sufficient in length and has strain relief
- gravity feed of the cable is proper and smooth
- cable is labelled as 'Laptop'.

When the cable cubby has a USB socket, this is to be connected to one of the USB ports on the resident computer, and labelled as 'USB'.

3.4.3 DOCUMENT CAMERA

The document camera must be controlled by the AV system. At a minimum it shall be powered on or off with the system.

The requirements for the installation of a document camera are:

- unit housed in a metal bracket firmly secured to the lectern
- cabling concealed and connections not interfered with by the articulated arm.

In lecture theatres and classrooms, the document camera is located on the lectern (or AVIP), as shown in the layout diagram of Appendix B.

3.4.4 WIRELESS PRESENTATION

The wireless presentation device must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. It shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device is to be configured as per Curtin recommendations (see Part 7 – Resource 4). The procurement of the device must include 5 years' maintenance to ensure access to the latest firmware.

3.4.5 MEDIA PLAYER OR STB

DVD and VCR media players are no longer provided as standard. If a media player (e.g. Bluray) or set top box (television receiver) is installed it must be configured in consultation with the Curtin AV Project team.

3.4.6 VIDEOCONFERENCING CODEC

The videoconference will be installed in its rack location with all cables securely connected, labelled and neatly arranged. The device must be configured for H323, SIP and authentication as per Curtin recommendations (see Part 7 – Resource 4).

The security credentials (admin password) are to be set as the Curtin default.

3.4.7 VC CAMERA

The videoconference cameras must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. The cameras must be installed according to the manufacturer's specification using supplied mounting brackets.

Where HDMI cables would to be longer than 15 m, extensions must be used with Extron DTP transmitter and receiver pairs over UTP.

3.4.8 WEB CAMERA

The web camera must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. All meeting rooms with a resident computer are to have a webcam installed at the display location (USB extenders may be required).

3.4.9 LECTURE CAMERA

The lecture cameras must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved. The cameras shall be installed according to the manufacturer's specification with particular attention to heights and distances from the 'capture zone'. Curtin AV Project staff should be consulted regarding the final location before installation.

For the iSmart range of auto-tracking cameras:

LT04

- mount height 1,750 mm AFFL
- distance to 'capture zone' 10 m
- adjustable elbow mount in tiered venues
- connect component cable to closest camera

MTC

- mount height 2,400 mm AFFL
- distance to 'capture zone' 5–15 m
- adjustable elbow mount in tiered venues.

There should be no vibration evident in the captured image. The camera settings must be configured as described elsewhere in these standards (see Part 7 – Resource 4).

3.4.10 STUDENT CAMERA

The student camera must be located immediately near the main front display and be facing into the audience. Curtin AV Project staff should be consulted regarding the final location before installation. Ensure that the integrated microphone is muted.

The security credentials (admin password) are to be set as the Curtin default.

3.4.11 SUPPORT CAMERA

Network cameras are used for remote assistance monitoring and should be mounted centrally in any room with clear line of sight to all displays and presentation areas. All classrooms must have a network camera installed.

The security credentials (admin password) are to be set as the Curtin default.

3.5 OUTPUT ENDPOINTS

3.5.1 DATA PROJECTORS

The data projector, mounting bracket and motorised lift (if required) must be selected from the Curtin list of standards components (see Part 7 – Resource 3).

The projector shall have the following specifications at a minimum:

- native 1920 x 1080 pixel resolution (1080p)
- compatible with 16:9 aspect ratio
- 4000 ANSI lumens or better, selected for the lighting conditions in the venue
- HDMI and/or DVI-D inputs
- 2000:1 contrast ratio or better
- low fan noise (less than 35dBA)
- IP control
- motorised focus and zoom
- lens shift.

Ultra-short throw projectors are only to be used for special purposes such as when paired with interactive whiteboards.

The requirements for projector placement including screen height, location above floor level, etc. are provided elsewhere in these standards (see Part 4 – Section 5). The other requirements for the installation of projectors are:

- Projectors must be installed to align with the top of the screen or projection surface. Optical lens shift may be used to correct image positioning. Electronic image correction (such as 'keystone') must not be used unless approved.
- Ensure that bulkheads or other ceiling fixtures do not obstruct the view of the projected image, nor interfere with ongoing maintenance of the projector.
- Ceiling brackets for projectors must be fixed to the building structure using an appropriate ceiling dropper.
- Projector brackets must include an equipment cage to securely house digital receivers and associated components.
- For ease of maintenance, ceiling-mounted projectors should not be positioned over fixed or tiered seating.
- A motorised lift must be installed with a projector that has to be mounted over tiered seating, is higher than 3.0 m AFFL or where servicing is otherwise difficult. The lift must lower to at least 1,200 mm AFFL. Cables that transverse the lift's scissor must be flexible and terminated at the ceiling. The lift must be controlled from the touch panel of the AV system.

All effort must be made to reduce or eliminate projector image shake caused by vibration within the building structure.

The projector settings must be configured as described elsewhere in these standards (see Part 7 – Resource 4).

3.5.2 PROJECTION SURFACE AND SCREENS

The Curtin preference is for unframed projection onto a painted white wall (zero gloss, matte, pure white with no tint). Walls used for projection must be finished to a Level 5 standard in accordance with AS/NZS2589, perpendicular to the projector (see also Part 6 for other requirements).

Where a drop-down screen is necessary (e.g. in front of a window or whiteboard), it must be motorised and controlled by the AV system via an IP interface. The picture surface must be matte white with a gain of 1.0, uniform reflectance beyond 60° off-axis and black masking borders. The screen fabric shall be flame and mildew resistant. The motor of the screen shall be mounted inside the rigid metal roller. The unit will have preset but adjustable limit switches configured for the 'up' and 'down' positions. The unit is to be mounted on vibration and noise absorbing supports.

3.5.3 FLAT PANEL DISPLAY

The flat panel display (FPD) must be commercial grade and selected from the Curtin list of standards components (see Part 7 – Resource 3) and shall have the following specifications at a minimum:

- native 1920 x 1080 pixel resolution (1080p)
- compatible with 16:9 aspect ratio
- luminance of at least 400 cd/m²
- three HDMI or DVI-D inputs
- IP control.

The requirements for FPD placement including screen height, location above floor level etc. are provided elsewhere in these standards (see Part 6 – Section 5). The other requirements for the installation of FPDs are:

- All power GPOs, connection places and cabling must be neatly concealed behind the display.
- FPDs are installed on wall-brackets or ceiling droppers, suitably fixed to the building structure for the weight being supported.
- Equipment mounted behind a large FPD shall be accessible for ongoing maintenance.
- If not locked, install a 5 mm diameter split pin in the mounting bracket security holes to prevent removal without tools.

The FPD settings must be configured as described elsewhere in these standards (see Part 7 – Resource 4).

3.5.4 DIGITAL SIGNAGE

For digital signage players, the following installation standards shall be followed:

- mounted securely behind flat panel
- easily accessible for maintenance.

3.5.5 LECTURE RECORDING DEVICE

The lecture recording device shall be installed in its rack location with all cables securely connected, labelled and neatly arranged. All signals reaching the device are to be scaled to HDMI 1080p.

The security credentials (admin password) are to be set as the Curtin default.

3.5.5.1 Recording Light

All installations with a lecture recording device require a recording light attached to the resident computer and reticulated neatly to a location visible by all seated audience positions.

3.6 POD OR COW

In the cases where an auto-switcher is utilised, it shall be set up to automatically select a connected laptop with priority over the resident computer.

3.7 AUDIO PERFORMANCE

The audio performance of the AV system must be verified using the items in **Table 3** based on ANSI/Infocomm 10:2013.

Table 3: Audio Performance Verification

Item	Title	Verification
AP-101	Loudspeaker Zoning	Audio should pass through amplifier output to correct loudspeaker(s).
AP-102	Alignment of Multiple Audio Source Levels	The gain structure has been set to achieve 'unity gain' (0 dBu) for each audio source after the first common gain adjustment. The variation between audio source levels must be less than 1 dB when playing test tone.
AP-103	Audio Buzz and Rattles	There is no audible noise caused by improper installation: <ul style="list-style-type: none"> • Buzz in any speaker at an audio level of 3 dB below onset of distortion when there is no content playback. • Rattle in any part of the system caused by continuous sweep signal operating at the level of 3 dB below onset of distortion.
AP-104	Audio Routes	All audio routes are tested for proper operation from endpoint to endpoint as shown in the system schematic (see also Appendix C). Provide a spreadsheet to demonstrate that each relevant cable has been tested.

Item	Title	Verification
AP-105	Reverberation Time	The reverberation time, measured using an impulse noise test with microphone at normal listening height, is less the 0.5 s (or as defined per frequency by the acoustician).
AP-106	DSP Programming	The DSP has been programmed based on the template provided by the University. Any changes are noted and the final design is handed over to CITS-AV.
AP -107	Loudspeaker Physical Alignment	Loudspeakers are correctly located, at specified height and aimed for maximum coverage of listener areas.
AP-108	Loudspeaker Polarity	Loudspeakers are tested for correct polarity using standard polarity tester set.
AP-110	Phantom Power	The phantom power supplied to condenser microphones is at correct voltage (e.g. 48 V) and provided on correct conductors.
AP-111	Loudspeaker Transformer Tap Setting	The loudspeaker transformer tap settings to be consistent and not to exceed amplifier output specification.
AP-112	Ambient Noise	The acoustical ambient noise of the venue for normal operating conditions is below that specified for the space type (typically 35 dB A-weighted).
AP-113	Hearing Augmentation Devices	The hearing augmentation subsystem is fully operational through to a personal listening device, including all regulatory requirements for signal strength.
AP-114	Audio Coverage in Listener Areas	The audio coverage in listener areas meets the performance requirements of ANSI/Infocomm 1M-2009. The coverage pattern is uniform within ± 5 dB over the entire seated area.
AP-116	Audio Level Exceeds Background Noise Level	The default audio level exceeds the background noise level by 25 dB S/N (measured in conjunction with AP-112).
AP-117	System Electronic Frequency Response	The system under test shall produce a flat frequency response (± 0.5 dB) from 200 Hz to 20 kHz.
AP-120	Audio System Reproduction at Listener Positions	Minimum acceptable value for STI = 0.6 measured at defined listener positions.

Item	Title	Verification
AP-122	Conferencing Audio Levels	The incoming and outgoing audio levels are checked and adjusted (see also AP-102 and AP-114).
AP-123	Conferencing Echo Suppression Performance	There is no perceptible acoustic echo for a listener calling into the conferencing system.
AP-124	Loudspeaker Impedance	All loudspeaker circuits have the correct impedance.
AP-125	Microphone Physical Alignment and Placement	Microphones are of the correct polar pattern, at the specified location and aimed for maximum pick-up of people talking in the venue.
AP-126	Microphone Gain Before Feedback	Microphones can be used within a safe and sufficient range of levels without creating feedback.
AP-127	Microphone Level Alignment	Microphones are calibrated to achieve 'unity gain' (0 dBu) after the first common gain adjustment. The variation between microphone levels must be less than 1 dB.
AP-130	Audio Reinforcement System Headroom	Audio levels are capable of being adjusted to highest operating setting without distortion.
WL-100	Wireless Audio Systems Operations	All wireless microphones are properly paired and tested for pick-up coverage, interference and dropouts over a 24-hour period.

3.8 VIDEO PERFORMANCE

The video and audio/video performance of the video system must be verified using the items in **Table 4** based on ANSI/Infocomm 10:2013.

Table 4: Video and Audio/Video Performance Verification

Item	Title	Verification
VP-100	EDID Management Plan	Extended Display Identification Data (EDID) management is configured to 1080p (default) with 720p as the alternative. Audio set to LPCM 2Ch. All inputs and outputs tested for these resolutions.
VP-101	HDCP Management Plan	High-bandwidth Digital Content Protection (HDCP) management is configured to allow content on HDCP-compliant output devices only.
VP-102	Projected Display Physical Alignment	Combined installation of projector and screen shows correctly aligned image.

Item	Title	Verification
VP-103	Video System Pixel Failure Tolerance	The maximum allowable number of pixel defects (bright, dead or discoloured) does not exceed manufacturer's specification.
VP-104	Image Geometry	All displayed images are correctly focused, have proper image geometry (e.g. circles are circles) and are free from distortion.
VP-105	Displayed Image Performance	All displayed images are correct with regard to image size, viewing angles, sight lines for all viewer locations as per project documentation.
VP-106	Colorimetry	All displayed images have been properly calibrated to show colours uniformly for HD SMPTE test pattern (SMPTE RP 219:2002).
VP -107	Multiple Resolution Performance of Video Displays	All input possibilities are tested to all output displays with no visual distortion or artefacts (e.g. letterboxing).
VP-108	Projected Display Brightness Uniformity	The brightness for all projected images is uniform within 85% across the full screen area (measured using photometer across 3 x 3 grid).
VP-110	Test Video Routes	All video routes are tested from endpoint to endpoint for proper operation as per project documentation.
VP-111	Video Camera Image and Operation	All cameras, lenses and pan/tilt systems have been tested through the full range of operating conditions.
AVP-102	Audio and Video Recording	All audio and video signals are being routed properly to the lecture capture device and recording is operating correctly.
AVP-103	Audio/Video Sync	Audio and video synchronisation is maintained during playback with maximum error of +40 mS (audio leading video) to -60 mS (audio lags video).
AVP-105	Source Testing	All audio and video produced by source devices used in normal operation are correctly routed through the system. Includes typical BYOD for the venue.
PHSYI-109	Optical Components Cleanliness	All optical components such as lenses and mirrors are free from dirt, dust, damage or markings.
WL-103	Wireless Video Systems Operation	The wireless video system (e.g. Solstice Pod) is tested for proper operation without interference or intermittent issues over a 24-hour period.

3.9 CONTROL PERFORMANCE

The control performance of the AV system must be verified using the items in **Table 5** based on ANSI/Infocomm 10:2013.

Table 5: Control Performance Verification

Item	Title	Verification
CON-100	Control Systems Communications	All control paths and functions are operational as per project documentation. This includes from processor to touch panel, control devices, networked devices.
CON-101	Control System Interfaces	All control system interfaces to BMS and lighting are operational.
CON-102	Mobile Device Integration	Any control functions managed by a mobile device (e.g. iPad) are operational and robust.
CON-104	Control System Automated Functions	All automated functions described in the project documentation are operational. Currently includes auto shutdown at end-of-day and after venue inactivity. Also includes each multi-function icon on the Quick Setup window on the touch panel.
CON-105	Control System User Interface Performance	All of the relevant tests described in the User Acceptance Test of Part 7 – Resource 6 are passed.
CON-106	Control System Response Time	All AV system responses to the control interfaces are responsive with minimal latency.
IT-113	Identity Management Plan	All devices in the AV System that require authentication credentials are correctly configured. Includes control processor, touch panel, DSP, wireless video, videoconference codecs, networked cameras etc.
IT-115	Remote Access	All devices that can be remotely accessed can be reached from the CITS-AV support VLAN.
IT-116	Remote Management	The AV system is correctly connected and can be monitored by the RMS application. The configuration and code/GUI updating can be managed by vControl.

4 SERVICES AND ENVIRONMENT

4.1 CABLING AND CABLE MANAGEMENT

4.1.1 GENERAL

As a general rule, and as much as practicable, the structured cabling system comprising the Curtin 'network' is to be used for distributing audiovisual signals over longer distances. In this regard the requirements for structured cabling system installations described in the CITS Networks cabling standards must be followed (see 000313 Data Cabling Network Requirements). Obvious exceptions are powered audio cabling to speakers and inter-device cabling within the AV system rack.

For all remaining audiovisual cabling, the requirements to follow are described in Part 6 – Section 8, including segregation from other services, minimum bend radius, and tray support systems. In addition:

- Surface duct or surface conduit must not be used unless specifically nominated on approved drawings.
- Cabling must be concealed where practicable in ceilings, floor ducts or in wall cavities.
- Cables shall be run without junctions or joins.
- Approved cable fasteners, such as Velcro ties, shall be used at 300 mm (min) and tightened firmly without distorting or applying undue pressure to the cables.
- A gentle drop loop is required between terminations and the first cable tie for strain relief of the cable.
- Cables must be bundled to a maximum of 12 cables and each bundle individually supported from a catenary wire or cable tray.
- During the installation of a cable, the pull distance should not exceed 30 metres at any one time.
- Patch leads shall be pre-made, of a suitable length with a minimum spare.
- All UTP/STP CATx not part of the Curtin 'network' must be distinguishable from data networking cabling with a purple coloured PVC sheath.

4.1.2 CABLE LENGTH LIMITS

The cable length limits that must be observed for each transmission technology are shown in **Table 6**.

Table 6: Maximum cable lengths

Type	Maximum
HDMI	15 m end-to-end
Line level audio	Up to where <1dB attenuation at 10kHz end-to-end (with matched low-Z drive, high-Z termination)
Speaker figure 8	Up to where round trip impedance <10% of speaker impedance
HdBaseT/XTP over CAT6a UTP or better	100 m end-to-end
10/100/1000 Mb/s Ethernet on CAT5e UTP or better	100 m end-to-end
USB	USB 2.0 – 5 m end-to-end USB 3.0/3.1 – 3 m end-to-end

Note: Where: 'end-to-end' means device to device including allowance for fly leads, patch leads etc.).

4.1.3 CABLE TYPES AND CONNECTORS

The cable types and connectors must be selected from the Curtin list of standard components (see Part 7 – Resource 3) unless otherwise approved.

4.1.4 PATCH PANELS

Detailed drawings must be submitted for approval prior to manufacture, indicating the layout and labelling of the patch panels.

As a minimum, the patch panels must be:

- suitably mounted in the AV equipment rack and sized to accommodate all terminations for audio, video and control cables
- labelled to identify the function of all terminations. Labelling text must be 6 mm high, capital letters, with black fill.

The connectors shown in **Table 7** must be used for each signal type.

Table 7: Patch Panel Connectors

Signal Type	Connector
Line level balanced audio	Bantam TRS or approved alternative
Line level unbalanced audio	TR ¼ inch, RCA or approved alternative
Microphone signals	3 pin XLR style connector or Bantam TRS.

Signal Type	Connector
Composite Video	BNC
VGA/RGBHV	5 x BNC, or 15-pin HD may be used with prior approval
DVI	DVI-I Dual link
HDMI	HDMI A Type connector
Ethernet	RJ-45 modular connector 8P8C
RS232/RS485	DB9

4.1.5 CONNECTION PLATES

All AV cabling shall terminate on suitable connection plates in the field. All connection plates must indicate the function for each nominated outlet, as shown in **Table 8**. The labelling must be durable and not easily removable such as using direct engraving, applied engraved labels, or machine-printed labels with 6 mm high capital letters.

The AV Integrator's name or logo is not to appear on any plates.

Table 8: Connection Plate Labels

Connection Plate	Connectors	Label
PC/Laptop Input – HDMI	1 x HDMI A type	LAPTOP HDMI
PC/Laptop Input – VGA	1 x VGA 15-pin HD connector 1 x 3.5 mm mini stereo jack for audio	LAPTOP VGA
Portable Audio Player Input	1 x 3.5 mm mini stereo jack for audio	AUDIO
Microphone Input	1 x XLR connector (female)	MIC
USB	USB connector (Type A plug)	USB

For connection plates associated with moveable AVIP (or lectern) terminations, the lowest plate shall be at least 300 mm AFFL, as shown in **Figure 1**. This height is to reduce damage from feet, vacuum cleaning etc.



Figure 1: Connection Plates for AVIP on Vertical Ducting

4.1.6 LOOMING AND LACING IN EQUIPMENT RACKS

The AV Integrator must adhere to the following requirements regarding looming and lacing in equipment racks:

- Bundle cables based on different signal types.
- Separation of the different signal types shall be a minimum of 100 mm.
- Cables for speaker level, RF, control, power, ground and networking should be bundled individually on the left. Cables for microphone level, line level, video, RGBHV and digital video cables should be bundled individually on the right.
- Dress all cables in neat looms and parallel runs using approved cable restraints and support bars.
- Leave sufficient length on all cables to allow removal of any item of equipment from the rack for a distance equal to the equipment depth + 50 per cent without disconnecting any cables.
- Cable bundles shall not obstruct installation or removal of equipment in the racks.
- Cover all cables entering and exiting the equipment rack with appropriately sized Techflex or equivalent black expandable braid cable sock. Cut expandable braid with a hot knife or otherwise treat sleeve ends to prevent fraying.

- Cable ties are not to be used. Rather Velcro ties must be used to ensure that the cables are not distorted during installation.

4.1.7 FLY LEADS

The AV Integrator shall provide all necessary AV fly leads for every connection plate and all patch leads necessary to enable the connection of a working system. All fly leads are to be factory pre-moulded, of suitable size to fit within cable trenches and ducts. Fly leads must be of sufficient length (but not excessive) for easy connection to the device when located in its typical location.

Fly leads installed in student or public spaces must be secured to prevent unauthorised removal. Nylon P-clips or other similar methods are acceptable.

Where a push-button controller is installed, the fly leads must be clearly labelled to match the wording on the appropriate push-button e.g. Laptop.

4.1.8 FLOOR BOXES

The floor box must be selected from the Curtin list of standard components (see Part 7 – Resource 3). Each connection plate in the floor box will have a 40 mm conduit for AV use only.

4.1.9 LABELLING

All cables must be labelled using the conventions described in this section.

For a typical cable there are two lines of information repeated twice to give four lines per label that, once wrapped around the cable, is readable from all directions.

← [location -] source_device – signal_type – [card#:]port# [- cable_type]
 [location -] destination_device – signal_type – [card#:]port# →

Features of this labelling include:

1. Items in square brackets are optional.
2. 'Location' is an optional prefix with reference to floor/room for centralised distribution points (i.e. Type 4 AV system).
3. 'Source_device' and 'destination_device' are indicated by a code based on the DNS naming code shown in Appendix D.
4. 'Signal_type' relates to the common name for the protocol used within the cable. The best reference is the connection name used on the device e.g. HDMI, XTP, DTP, SDI, USB, MIC, LINE, SPKR, SERIAL, LAN, 12VDC, 240VAC.
5. 'Card#' is an optional reference to the card slot indicated on the device.
6. 'Port#' is the port number, generally indicated on the device.
7. 'Cable_type' is an optional suffix if the cable needs have specific characteristics, e.g. USB3. Alternatively, this suffix may reference the notation used on the as-built schematic diagram provided by the AV Integrator.

The label must also have the following characteristics:

Durability – Labels shall have a design life equal to or greater than the cable.

Material – capable of receiving machine-printed letters.

Legibility – All capitals, non-bold, non-italic, at least 2.5 mm letters in sans serif font. Margins at least 1 mm. Colour contrasting to label background.

Orientation – parallel to axis of cable.

Location – between 25 and 300 mm (150 mm typical) so the label can be read without twisting, and not obscured by other cables, cable ties, or tie bars.

Consistency – between labels in material, orientation, location, font size, colour.

4.1.10 VERIFICATION

The cabling and cable management must be verified using the items in **Table 9** based on ANSI/Infocomm 10:2013.

Table 9: Cabling and Cable Management Verification

Item	Title	Verification
CABL-100	Cable Bend Radius	Cables in the AV system are not bent beyond their minimum bend radius as specified by the cable data sheet. Check problem areas such as racks, junction boxes, ducting corners and connection plates.
CABL-101	AV Connector Plate Labelling	All AV connector plates have input and output labelling as per project documentation and/or Section 4.1.5.
CABL-102	AV Connector Seating	All AV connectors are correctly keyed, seated and latched.
CABL-103	AV Cable Termination Verification	All cable terminations are made securely and meet the recommendations of the connector and cable manufacturer.
CABL-104	AV Power Cable Management	All AV equipment power cables are properly managed so as not to compromise safety, AV signal quality (e.g. through separation) and serviceability.
CABL-105	AV System Cable Labelling	All AV system cables have labelling including a unique ID as per project documentation and/or Section 4.1.9.
CABL-106	Cable Separation	All site and rack cables have appropriate segregation according to signal type as per project documentation and/or Section 4.1.6.
CABL-107	Cable Support	All cables are supported throughout their lengths as defined in Curtin's 000313 Data Cabling Network Requirements document.
CABL-108	Cable Ties	Cable ties are placed in a neat and orderly fashion, correctly tensioned, as per project documentation and/or Section 4.1.1.

Item	Title	Verification
CABL-109	Cables Bundled by Type	Cables are bundled only when signal type and level are compatible and will not cause crosstalk or interference (see also Section 4.1.6).
CABL-110	Cables Dressed	All site and rack cables are laid out to ensure serviceability, safety and aesthetics as per project documentation and/or Section 4.1.6.
CABL-111	Patch Panel Configuration	All patch panels are correctly wired as per project documentation.
CABL-112	Patch Panel Labelling	All patch panels are correctly labelled as per project documentation and/or Section 4.1.4.
CABL-113	Termination Stress	All cable terminations are completely supported with adequate strain relief to minimise stress on the connection points.
CABL-114	Consistent Labelling	All labelling is consistent with as-built schematic drawings, touch panel layouts, connections plates etc.
CABL-115	AV System Cabling Verification	All cables are of the correct type and routed correctly as per project documentation.
CABL-116	Cable Length for Serviceability	All cable lengths are of sufficient length to allow devices to be moved to serviceable locations without exceeding cables minimum bend radius.

4.2 EQUIPMENT HOUSING

4.2.1 RACKS

The requirements for racks containing audiovisual equipment are described in Part 6 – Section 8 of these standards. In summary:

- 19-inch equipment rack width
- sizing to accommodate equipment plus 20 per cent spare capacity
- vertical and horizontal cable management, including a minimum of 2 x 100 mm cable trays fitted to the inside of the equipment rack
- power surge protection
- allowance for security panels
- heavy-duty castors to allow the rack to be pulled out of the cupboard for servicing
- rack elevation drawing to be issued to Curtin AV Projects team prior to ordering of rack or rack construction
- allowance of 1 RU spaces between all devices
- one 2RU rack drawer to be provided for remotes

- keys to be handed over at finish of job.

The preferred rack layouts for Type 2, Type 3 and Type 4 AV systems are shown in Appendix E.

4.2.2 LECTERNS AND CABINETS

The access doors for any furniture that houses AV equipment are to be secured using a BMB AO-25 lock (or alternatively Hafelle 0025). When a computer is installed behind a locked door then a cut-out for user access will likely be required. A digital code lock (Borg) may be required on any furniture doors that are to be accessed by lecturers, end users, etc.

The joinery must have 100 mm gaps from front, back, top and sides of an installed rack. The ventilation grilles in the lower part of door and/or sides, and the grille on top must be sized to provide adequate natural airflow by convection. There should be no plinth where a rack is on rollers to allow for rack serviceability. Services such as power and data should be mounted within the joinery.

Strain relief is to be provided on an AVIP loom with an eyebolt fixed to the floor and Velcro around the braided sheath to avoid termination/connector damage when the AVIP is moved.

Racks inside AVIPs are to be fixed down and tied together.

4.2.3 TELEPHONES

Please make allowance for a UTP port on the wall located near the lecturer's position for AV support calls. CITS – Networks is to provide support and install the phone.

4.2.4 SECURING EQUIPMENT

To prevent theft or unauthorised removal of equipment, the following security measures are to be used:

- Rack equipment must be secured by a locked door or security screws where no door is installed.
- Surface-mounted equipment must be secured by screws, industrial velcro or foam-backed double-sided tape.
- Document cameras are to be encased in a custom-made housing screwed to the surface from below.
- USB and other portable items are to be secured by combination Kensington brand locks.
- Revolabs and handheld microphone base stations are to be secured with industrial strength foam-backed double-sided tape.

4.2.5 VERIFICATION

The equipment housing must be verified using the items in **Table 11** based on ANSI/Infocomm 10:2013.

Table 10: Equipment Housing Verification

Item	Title	Verification
PHYSI-101	AV Rack Airflow	The airflow in AV rack is effective in keeping the internal temperature below 35 °C (measured front and back; top, middle and bottom).
PHYSI-102	Equipment Security	All equipment described as 'secured' in project documentation is properly secured. Includes resident computers, FPDs and cameras.
PHYSI-103	AV Equipment Labelling	All equipment in AV racks is labelled using the same device name as in the 'as-built' schematic diagrams. Labels must be consistent, durable, accurate and visible.
PHYSI-106	AV Equipment in Rack	All equipment in AV racks is installed in the location shown on rack layout diagrams.
PHYSI-107	AV Rack Cleanliness	All components installed in AV racks are free from dust, dirt, water or any other element that would compromise the performance and/or longevity of the AV system.
PHYSI-108	Controls Protection	Any equipment controls that should not be accessed by the end user are covered, disabled or otherwise secured.
SERV-103	Rack Clearance	Verify AV rack placement, physical stability and clearances as identified in project and regulatory requirements.

4.3 NETWORK

4.3.1 PATCHING

Networked devices are to be patched in the following order from lowest UTP port number to highest (as applicable).

AVIP TYPE 2/3:

1. PC – VLAN 396
2. SCHD– VLAN 396
3. Wireless presenter – VLAN 397
4. Touch Panel – VLAN 399
5. Controller – VLAN 399
6. Presentation switcher – VLAN 399
7. AV bridge – VLAN 399
8. EPDU – VLAN 399
9. DSP Core – VLAN 399
10. Microphone receiver – VLAN 399.

AVIP TYPE 4:

1. PC – VLAN 396 (backup)
2. Touch Panel – VLAN 399
3. DSP IO– VLAN 399.

TYPE 4 RACK IN AV COMMUNICATIONS ROOM:

1. PC – VLAN 396
2. SCHD– VLAN 396
3. Wireless presenter – VLAN 397
4. Controller – VLAN 399
5. Crosspoint Frame – VLAN 399
6. Qsys –CORE – VLAN 399
7. AV bridge – VLAN 399
8. EPDU – VLAN 399
9. SVSI Decoder – VLAN 399
10. VC codec – VLAN 398.

4.3.2 IP PROVISIONING

The AV Integrator must complete all the relevant fields in the supplied Device and Network Information Sheet (See Part 7 – Resource 7 for template) to enable CITS–AV to generate IP allocations.

All devices shall be set to DHCP where capable.

The network time server IP address shall be 134.7.134.17 (ntp.curtin.edu.au).

4.3.3 DNS

The DNS naming convention for AV equipment uses the format described in Appendix D.

4.4 PHYSICAL ENVIRONMENT

4.4.1 ELECTRICAL

The design requirements for AV system power are described in Part 6 of the AV Standards set. Where moveable furniture contains AV equipment then the requirements of Curtin’s soft wiring system design standard (found in 000312 Electrical Services Guidelines) must be followed.

4.4.2 LIGHTING

The lighting requirements for the physical environment are described in Part 6 of the AV Standards set. In particular, the lighting levels for typical teaching modes should be measured as conforming to minimum requirements.

4.4.3 VERIFICATION

The physical environment for the AV system must be verified using the items in **Table 11** based on ANSI/Infocomm 10:2013.

Table 11: Physical Environment Verification

Item	Title	Verification
ELEC-100	Equipment Connected to Proper Circuit	Confirm with installation electrician that the proper circuit is being used and outlets are correctly located.
ELEC-101	Grounding/ Earthing	All equipment in the AV system is properly bonded to an electrical ground/earth as per local and regulatory requirements.
ELEC-102	Mains Voltage Sub-Distribution Integrity	All power distribution units in the AV system are tested to meet local and regulatory electrical integrity requirements.
ELEC-103	Power Sources	Verify the mains voltage AC power has been properly tested by the installation electrician (e.g. view the report).
ELEC-104	Power Sequencing	All powered equipment turns on in the correct order and at the correct timing as per project documentation.
ELEC-105	UPS Operation	The uninterruptable power supply (UPS) is performing to specification.
ELEC-106	DC Power Distribution	All DC-powered devices are receiving the proper voltage and current for normal operation.
ELEC-107	Power Loss Recovery	The AV system resumes normal operation on the restoration of power following a hard electrical power outage.
ELEC-108	Power Monitoring	Not currently monitored.
IT-109	Power over Ethernet (PoE)	All devices using PoE are supplied with the correct power required for normal device operation.
PHYSE-102	Lighting	The lighting, as controlled by the AV system, provides the minimum lux requirements for student note-taking, presenter and whiteboard illumination for presentation and videoconferencing teaching modes (see Part 6 of the AV Standards set).
PHYSE-103	Vibration	Verify that vibration induced by building plant or external sources does not affect projected or captured image quality.

Item	Title	Verification
PHYSE-109	Floor/Wall/Ceiling Boxes	All installed boxes meet project and regulatory requirements.
PHYSE-112	Structural Mounting	All equipment mounting hardware is installed to the manufacturer's specifications.
PHYSE-114	Accessibility	All devices requiring user interaction have been installed to be accessible for all users regardless of height or disability.
SERV-100	Access Panels	Verify the access panels are properly sized and positioned to service AV equipment, wiring and connections.

5

APPENDIX A: GLOSSARY OF TERMS

Term or Acronym	Definition
720p	Video mode characterised by a progressive scan signal with a resolution of 1280 x 720 pixels
1080p	Video mode characterised by a progressive scan signal with a resolution of 1920 x 1080 pixels
4K	DCI standard resolution of 4096 pixels x 2160 lines native
AEC	Acoustic Echo Cancellation
AFFL	Above Finished Floor Level
ANSI	American National Standards Institute
AS	Australian standard
AV	Audiovisual
AVB	Audiovisual Bridging
AVIP	Audiovisual Interface Point (usually mobile)
Audio	Any audio signal in either analog or digital form
Balanced	A signal of opposite polarity to each other typically used to carry microphone signals
BYOD	Bring Your Own Device, e.g. laptop, tablet, smart phone.
CAT 5e	Category 5e cabling
CAT 6a	Category 6a cabling
CEC	Consumer Electronics Control
CITS	Curtin Information Technology Services
CITS-AV	CITS Audiovisual (project and support team)
Coax	Coaxial cabling
Codec	A device capable of coding and decoding a digital stream of data
CTS	InfoComm Certified Technology Specialist
DA	Distribution Amplifier

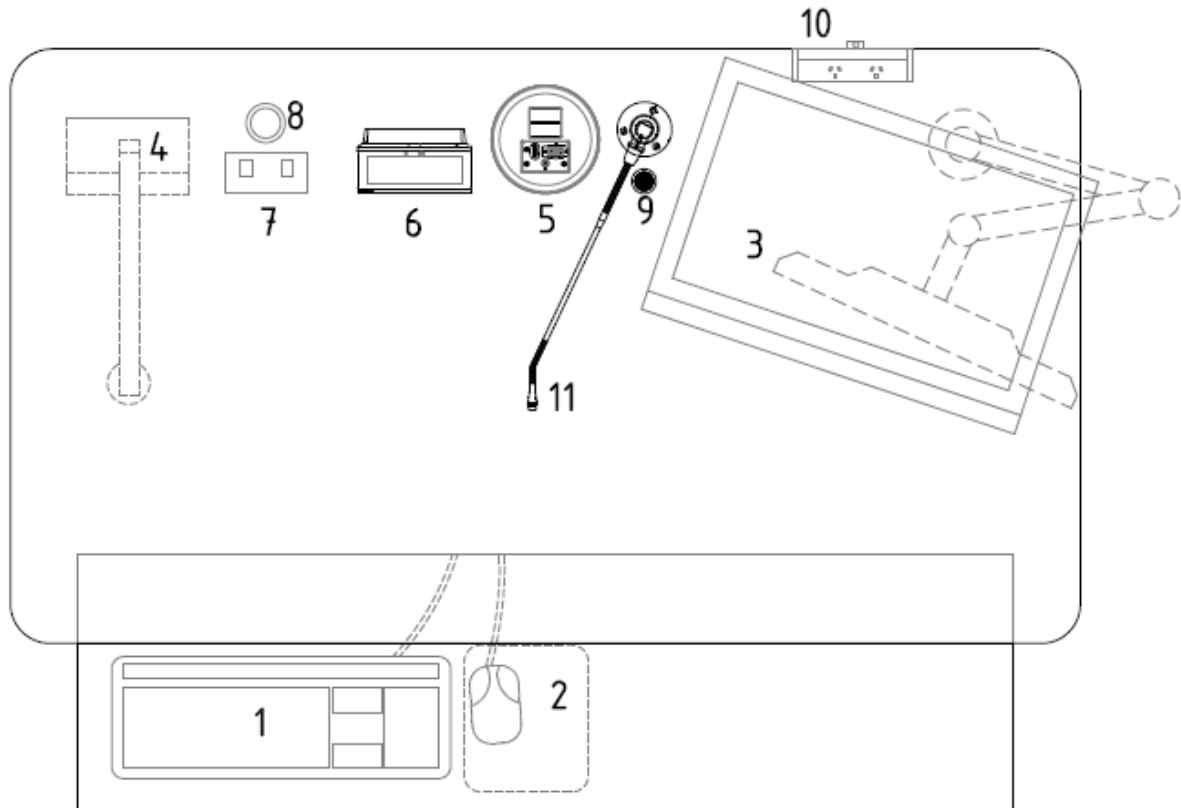
dB	Decibel, a unit qualifying a signal with respect to a reference
DGPO	Double General Purpose Outlet
DIP	Dual in-line Package
DP	DisplayPort
DVI	Digital Visual Interface
EDID	Extended Display Identification Data
EWIS	Emergency Warning Intercommunications System
FOH	Front of House
FPD	Flat Panel Display
GPO	General Purpose Outlet
HD	High Definition
HDCP	High-bandwidth Digital Content Protection
HDMI	High Definition Multimedia Interface
HDTV	High Definition Television
ICT	Information and Communications Technology
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IP	Internet Protocol
IPTV	Internet Protocol Television
IR	Infra-Red
IT	Information Technology
Kbps	Kilobits per second
KVM	Keyboard/Video/Mouse
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode

Lumen	Measure of luminous flux. In this document ANSI lumens
MATV	Master Antenna Television
Mbps	Megabits per second
MPEG	Moving Picture Experts Group
NCC	National Construction Code
PA	Public Address
PC	Personal Computer
PF & D	Properties Facilities and Development
PoE	Power over Ethernet
PIP	Picture-In-Picture
PTZ	Pan/Tilt/Zoom
RGBHV	Red Green Blue Horizontal sync Vertical sync
RJ45	Registered Jack 45. Standard computer networking connector
RS232/RS485	Recommended Standard 232/485. Used for serial binary single-ended data/control signals
Rx	Receiver
SD	Standard Definition
SDI	Serial Digital (video) Interface – broadcast standard for transport of uncompressed video
SNR	Signal to Noise Ratio
S/PDIF	Sony/Philips Digital Interconnect Format
STB	Set Top Box
STP	Shielded Twisted Pair (cabling)
TCP-IP	Transmission Control Protocol – Internet Protocol
TP	Twisted Pair (cabling)
Tx	Transmitter

USB	Universal Serial Bus
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair (cabling)
VC	Videoconferencing
VGA	Video Graphics Array –progressive scan signal at 640 x 480 pixels
VLAN	Virtual Local Area Network
VoIP	Voice over IP (telephony)
WAN	Wide Area Network
WAP	Wireless Access Point
WLAN	Wireless Local Area Network
Wi-Fi	Wireless Fidelity
YC, Y/C, S-Video	Separate Video – video signal characterised by Luminance (Y) and Chrominance (C) signals on separate cables
YCbCr/YPbPr/YUV	Component Video signal

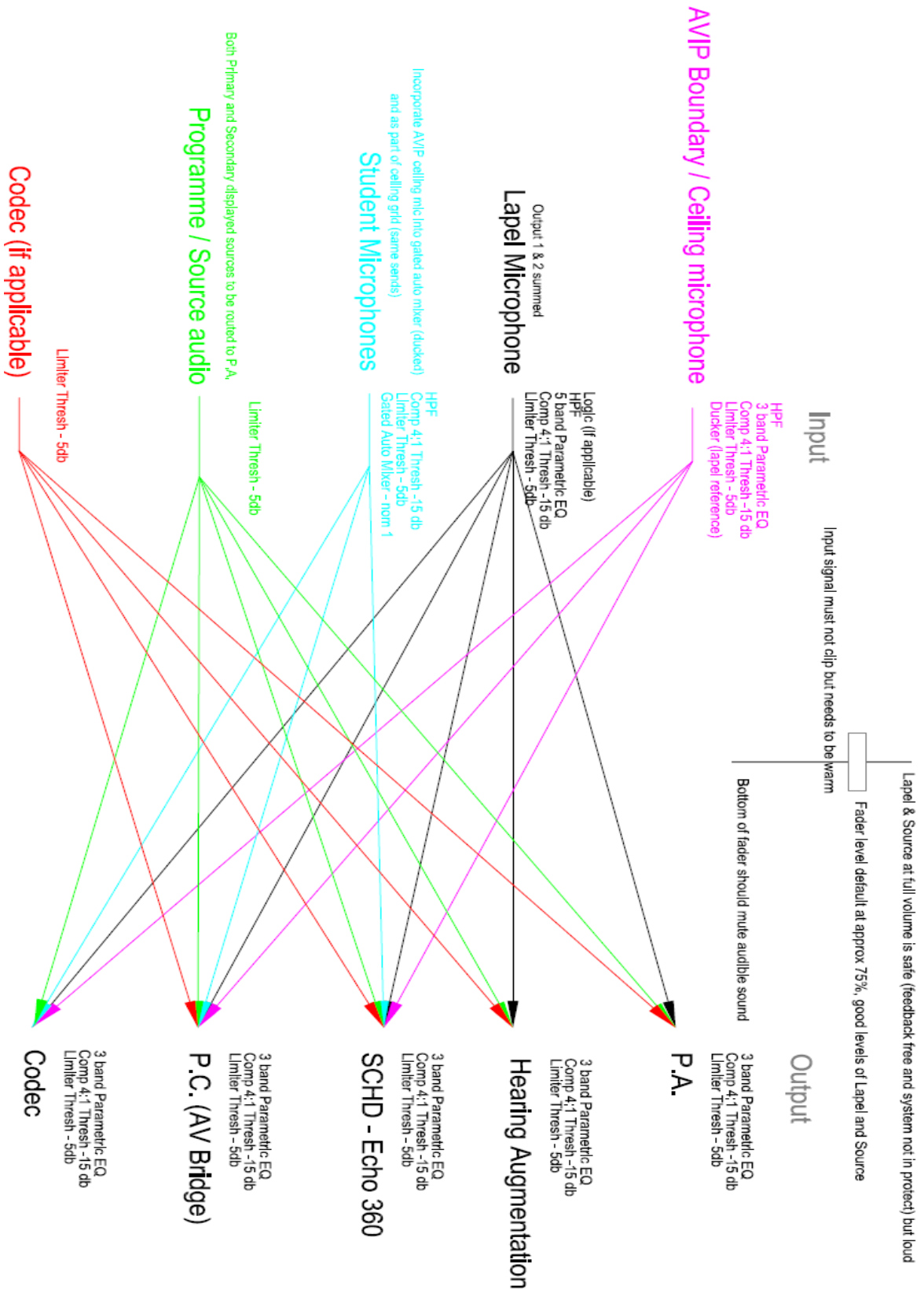
6 APPENDIX B: LECTERN (AVIP) LAYOUT

The figure below shows the recommended layout for the presentation surface on a lectern or AVIP. The layout can be mirror reversed as required to suit the venue orientation.



1. Keyboard
2. Mouse
3. Monitor or interactive tablet on articulated arm
4. Document camera in secure housing
5. Cable cubby
6. Touch panel
7. Wireless microphone charger
8. USB recording status light
9. Boundary microphone
10. Clamp-on power outlets
11. Lectern Microphone (if fitted)

APPENDIX C: AUDIO ROUTING AND PROCESSING



8 APPENDIX D: DEVICE CODES

Device Type	Description	Usage	DNS
ALS	Assisted Listening System	Cabling	N/A
AMP	Audio Amplifier	Cabling	N/A
ATV	Apple TV	All	b[Building]-[Room]-atv[Instance]. av.curtin.edu.au
AVB	AV Bridge	All	b[Building]-[Room]- avb.av.curtin.edu.au
CAM	Camera - Lecturer\Student\Room	All	b[Building]-[Room]-cam[Instance]. av.curtin.edu.au
CAMS	Camera - Support	All	b[Building]-[Room]- cams.av.curtin.edu.au
CAP	iLecture Capture Device	All	b[Building]-[Room]- cap.av.curtin.edu.au
CBUS	C-Bus Controller	All	b[Building]-[Room]- cbs[Instance].av.curtin.edu.au
CTL	Control System	All	b[Building]-[Room]- ctl.av.curtin.edu.au
CTLIO	IO Multi-Device Controller	All	b[Building]-[Room]- ctl.io.av.curtin.edu.au
CTLPB	Push Button Controller	All	b[Building]-[Room]- ctlpb.av.curtin.edu.au
CTLPS	Presentation Switch	All	b[Building]-[Room]- ctlps.av.curtin.edu.au
DA	Distribution Amp	All	b[Building]-[Room]- da.av.curtin.edu.au

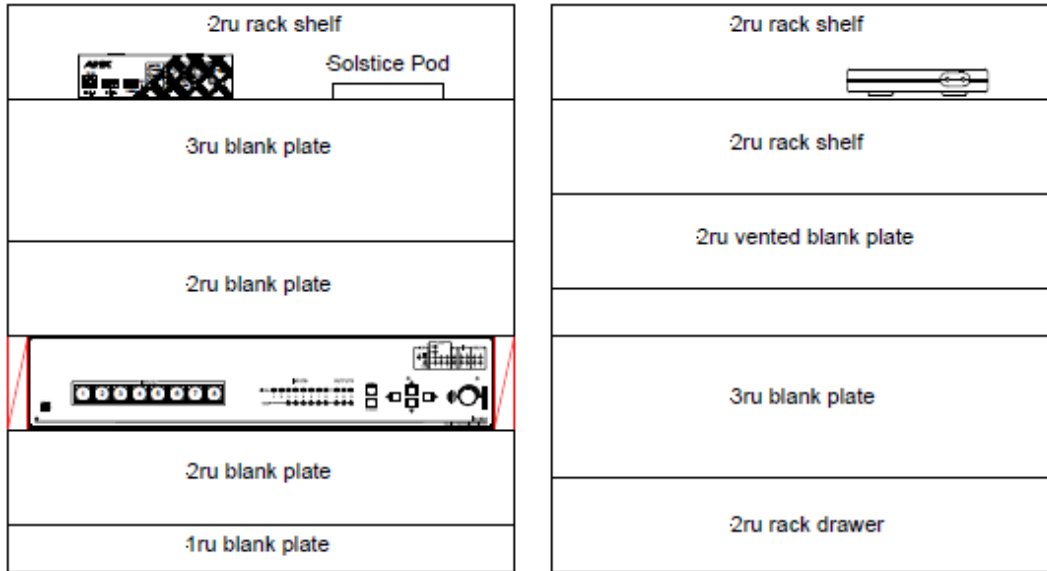
Device Type	Description	Usage	DNS
DAL	iLecture DelCom Light	Cabling	N/A
DEC	Digital Decoder	All	b[Building]-[Room]-dec[Device Instance]. av.curtin.edu.au
DIO	Digital I/O Controller	All	b[Building]-[Room]-dio[Instance]. av.curtin.edu.au
DOC	Document Camera	Cabling	N/A
DRX	Digital Receiver	All	b[Building]-[Room]-drx[Device Instance]. av.curtin.edu.au
DSP	Digital Signal Processor	All	b[Building]-[Room]- dsp.av.curtin.edu.au
DSPIO	Digital Signal Processor I/O	All	b[Building]-[Room]- dspio.av.curtin.edu.au
DSPIOF	Digital Signal Processor Frame	All	b[Building]-[Room]- dspiof.av.curtin.edu.au
DSU	Digital Signage Unit	All	b[Building]-[Room]-dsu[Instance]. av.curtin.edu.au
DTX	Digital Transmitter	All	b[Building]-[Room]-dtx[Device Instance]. av.curtin.edu.au
ENC	Digital Encoder	All	b[Building]-[Room]-enc[Device Instance]. av.curtin.edu.au
FPD	TV Display	All	b[Building]-[Room]-fpd[Instance]. av.curtin.edu.au
FRM	Switching Frame	All	b[Building]-[Room]-frm[Instance]. av.curtin.edu.au

Device Type	Description	Usage	DNS
GPO	General Power Outlet	Cabling	N/A
KYB	Keyboard	Cabling	N/A
MIC	Microphone	Cabling	N/A
MICBND	Microphone - Boundary	Cabling	N/A
MICCLN	Microphone - Ceiling	Cabling	N/A
MICRX	Microphone - Receiver	All	b[Building]-[Room]-mic[Instance]. av.curtin.edu.au
MICTBL	Microphone - Table	Cabling	N/A
MPS	Motorised Projector Screen	All	b[Building]-[Room]-mps[Instance]. av.curtin.edu.au
MSE	Mouse	Cabling	N/A
PC	Computer	All	b[Building]-[Room]- pc.av.curtin.edu.au
PCG	Guest Computer	All	b[Building]-[Room]-[ENC\DEC]- pcg.av.curtin.edu.au
PCB	POD Computer	All	b[Building]-[Room]-[ENC\DEC]-pcp[Instance].av.curtin.edu.au
PDU	Power Distribution Unit	All	b[Building]-[Room]-pdu[Instance]. av.curtin.edu.au
PRJ	Projector	All	b[Building]-[Room]-prj[Instance]. av.curtin.edu.au
SPB	Cisco SparkBoard	All	b[Building]-[Room]-spb[Instance]. av.curtin.edu.au

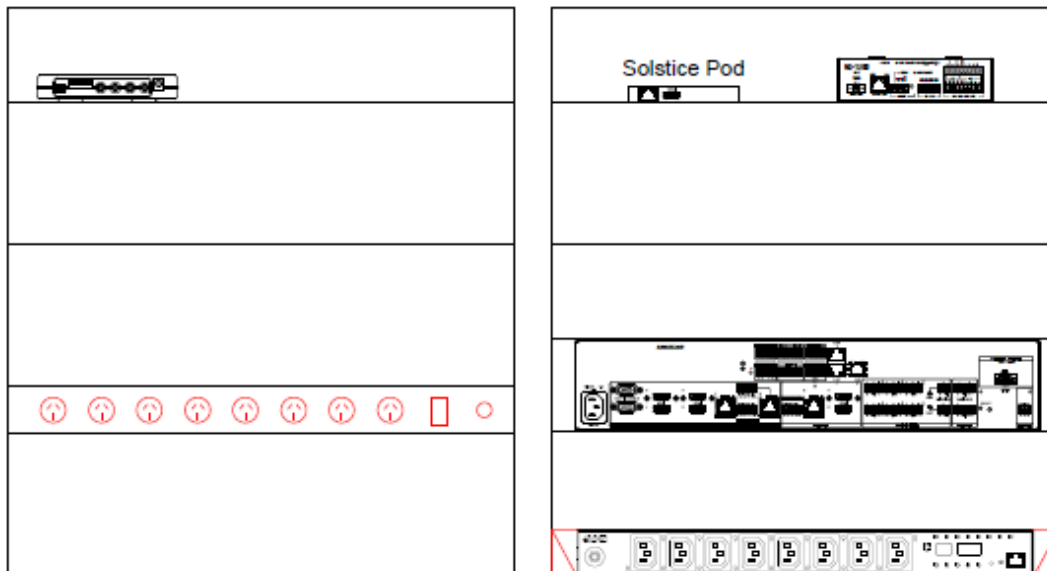
Device Type	Description	Usage	DNS
TPL	Touch Panel	All	b[Building]-[Room]- tpl.av.curtin.edu.au
TPLV	Virtual Touch Panel	All	b[Building]-[Room]- tplv.av.curtin.edu.au
UPS	Uninterrupted Power Supply	All	b[Building]-[Room]-ups[Instance]. av.curtin.edu.au
USB	Universal Serial Bus	Cabling	N/A
USBE	USB Extender	Cabling	N/A
VC	Videoconferencing Unit	All	b[Building]-[Room]- vc.av.curtin.edu.au
WPR	Wireless Presentation	All	b[Building]-[Room]- wpr.av.curtin.edu.au

LEC02 AVIP 2 x 12ru racks

Front View

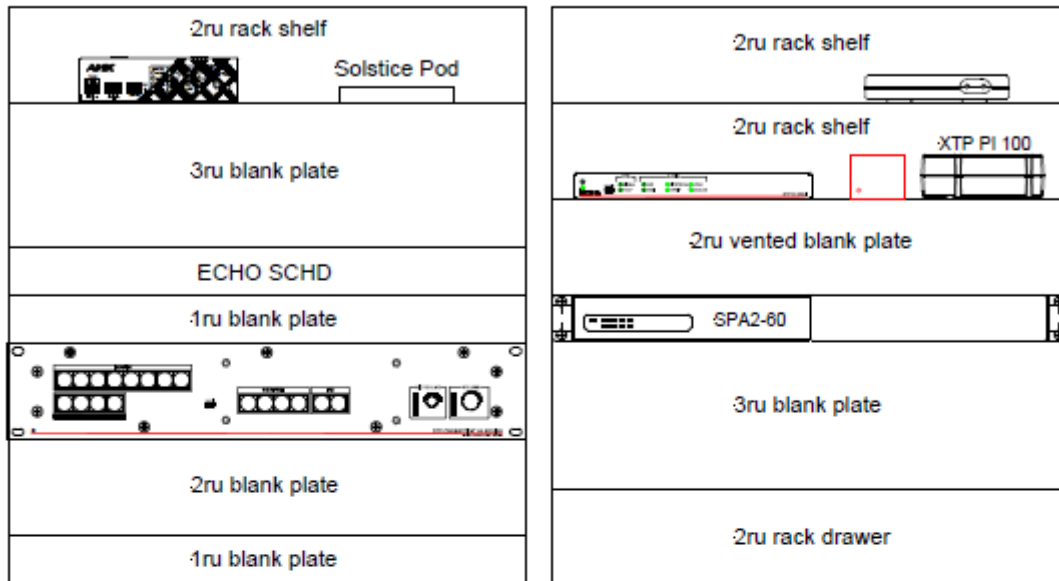


Rear View

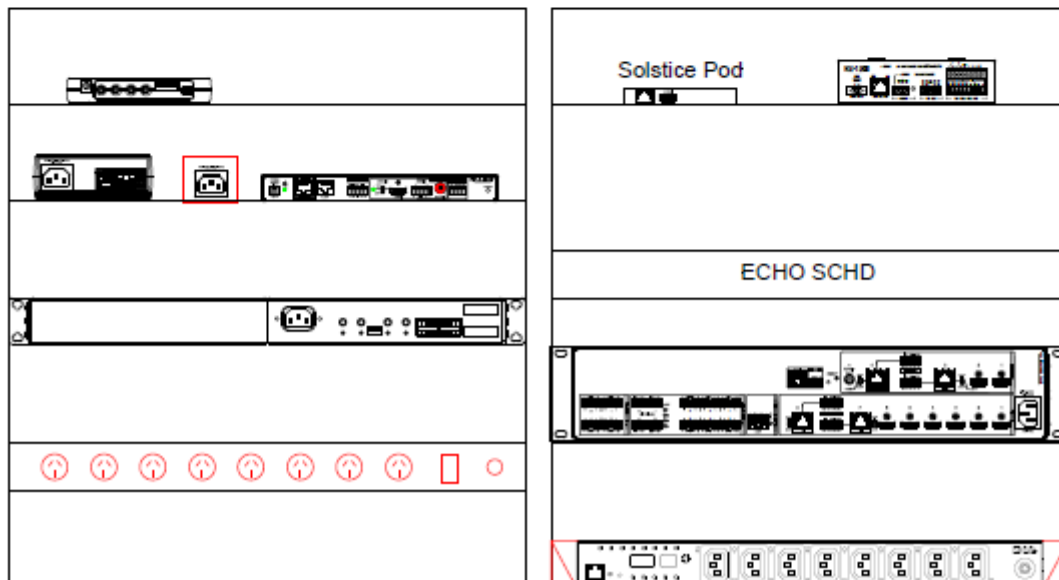


LEC03 AVIP 2 x 12ru racks

Front View

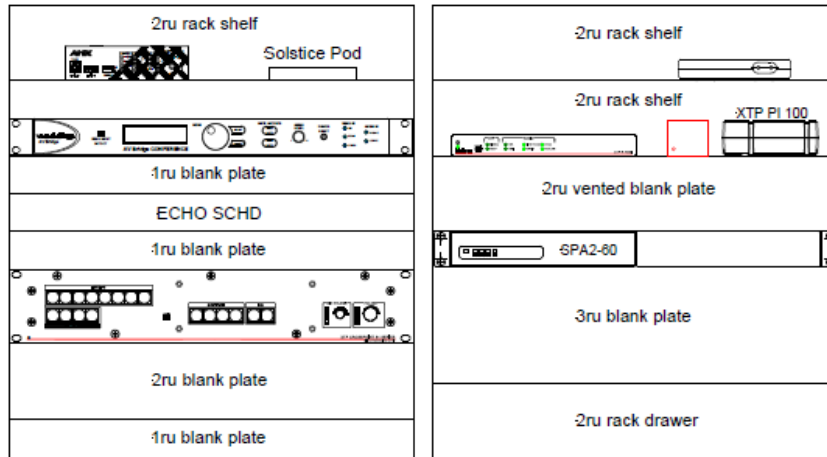


Rear View

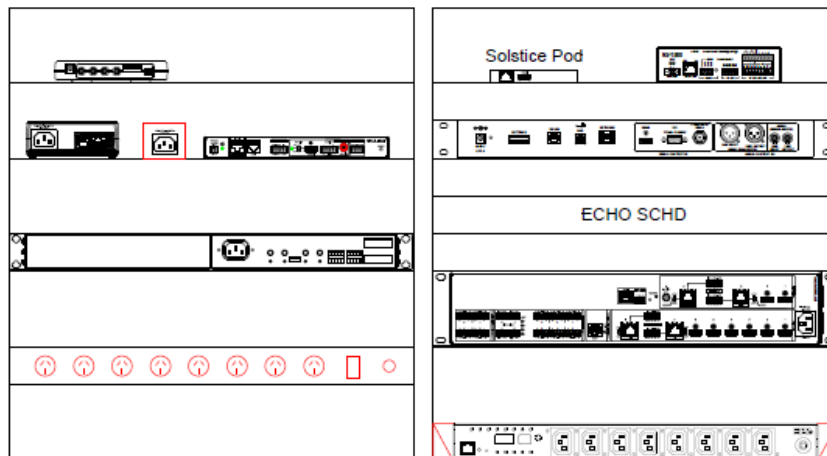


LEC04/CLB01/CLB02 AVIP 2 x 12ru racks

Front View



Rear View



MET02 12ru rack

Front View

Rear View

